LI-1: Epithermal Neutron Beam Design based on MNSR for BNCT

Li-Yiguo, Peng Dan, Wu XiaoBo, Hong Jingyan, Hao Qian, Wang Mengjiao

China Institute of Atomic Energy (CIAE), Beijing, 102413, P.O.Box 275-75, China
ygli97@139.com

Miniature Neutron Source Reactor (MNSR) is designed and built by China Institute of Atomic Energy for NAA, Physics experiment, Training and teaching. MNSR with thermal power 30kW is an undermoderated reactor of pool-tank type, UAL with ^{235}U enrichment of 90 % as fuel, light water as coolant and moderator, and metal beryllium as reflector. The fission heat produced by the reactor is removed by the natural circulation. MNSR has one fuel assembly, which is located at the bottom of the reactor vessel. The fuel assembly consists of the fuel cage ("Birdcage"), the control rod guide tube and fuel elements. Ten circles of lattices are concentricily arranged in the upper and lower grid plates, there are 351 lattice positions in the grid, among which the central one is specified as the control rod guide tube position. The five tie rods are uniformly arranged at the eighth circle. The rest lattice positions are preserved for fuel rods, while keeping the MNSR core size unchanged, UO_2 with ^{235}U enrichment of 19.75% was used to replace UAL with ^{235}U enrichment of 90%, the epithermal neutron beam for BNCT based on MNSR with 30kW and LEU core(Fig. 1), which is located on the bottom of the core, is designed. the different materials, such as, Pb, ALF_3, Cd, Al, polyethylene with Boron, etc, are adopted. MCNP is used for the calculation, the distance from the center point of the MNSR core to the exit of the epithermal neutron beam is 160 cm, the radius of exit is 6 cm. The main results at the exit are: Epithermal neutron flux rate is 1.297E+09 $n \cdot cm^{-2} \cdot s^{-1}$; Thermal neutron flux rate is 4.710E+07 $n \cdot cm^{-2} \cdot s^{-1}$; Ratio of γ dose rate to epithermal neutron flux rate is 1.322E-11$cGy \cdot cm^2$; Ratio of fast neutron dose rate to epithermal neutron flux rate is 3.600E-11$cGy \cdot cm^2$.

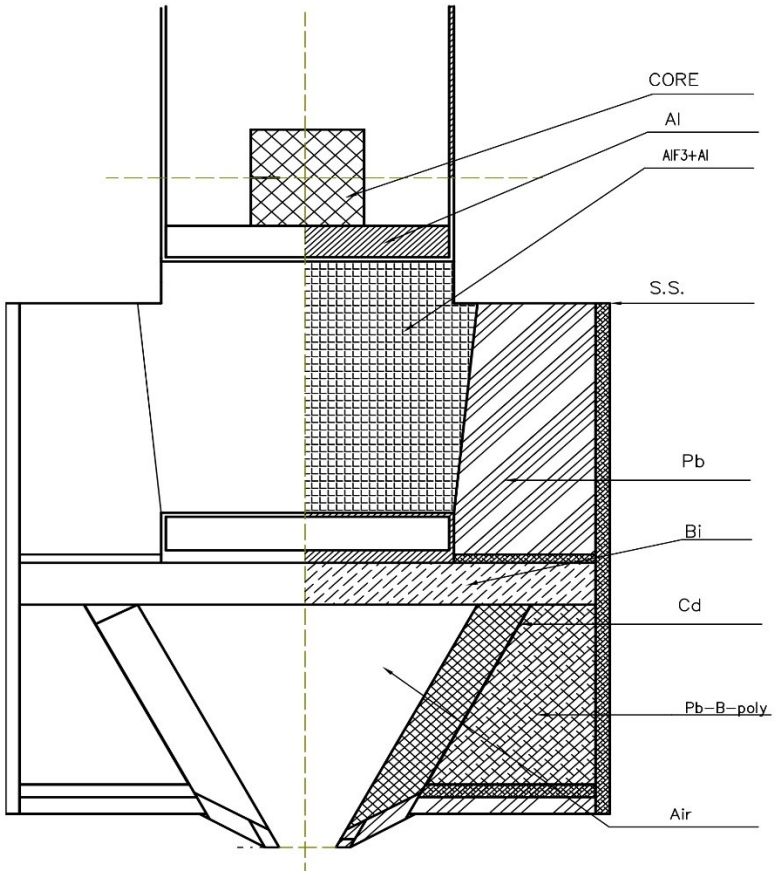

Fig. 1 Epithermal Neutron Beam